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Note respecting the recent Pendulum Experiments in the Harton Colliery. By G. B. Airy, Esq., Astronomer Royal.

Since the last meeting of the Society, the computations of the pendulum experiments in the Harton colliery have been completed, and the result appears very satisfactory. The pendulums do not appear to have received the slightest injury or change during the operations of interchange of position. The final result for the pendulums is,—

Acceleration at the bottom of the mine is 2·25 vibrations per day; or,

Increase of gravity at the bottom of the mine is $\frac{1}{19190}$ part of the whole.

Surveys will now be made for obtaining those data which are necessary in order to deduce, from this first result, the final result as to the earth's density. Until these are finished, no approximate result can be given with confidence: it appears likely, however, that the resulting density of the earth will be greater than those hitherto obtained.

December 8, 1854.

On the Satellite of Neptune. By J. R. Hind, Esq.

A discussion of the valuable series of observations of the satellite of *Neptune*, taken at Valetta in 1852, by Mr. Lassell, has led me to a result which may not be without interest, as hitherto only one instance of the kind was known to occur in the planetary system. There can be no doubt that the motion of the satellite is *retrograde;* and it offers a far more decided case of retrograde movement than the Uranian system, the inclination of the orbit of *Neptune's* attendant being only 29°, whereas the satellites of *Uranus* revolve in a plane which is inclined to the ecliptic more than 79°.

From a considerable number of observations I found the place of the ascending node, in the retrograde orbit, in longitude 175° 40′. It follows, therefore, from the present position of the planet in the ecliptic, that the apparent orbit of the satellite is gradually contracting, and will become a right line in 1859, when the line of nodes is directed towards the earth. Mr. Lassell has informed me that this is confirmed by his recent observations, in which the satellite was found to pass nearer to the planet than at the time of its discovery—a circumstance irreconcilable with *direct* movement, since, in that case, the place of the node would be behind the present position of *Neptune* on the ecliptic, and the apparent orbit of the satellite would necessarily be opening.

Another inference may be drawn from the observations of

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1852, namely, the existence of a very considerable ellipticity in the orbit, though, unfortunately, the determination of its precise amount, as well as a fair approximation to the position of the line of apsides, are scarcely practicable from present data; and since the apparent ellipse is rapidly approaching to a right line, we must wait 12 or 14 years before the measures necessary for completing the investigation can be obtained.

It will therefore be understood, that the position of the peri-neptunium and the angle of eccentricity in the following elements are very uncertain, though the inclination and node, and also the period of revolution, are, I believe, pretty exact.

Epoch 1852, November 0·0, Greenwich M.T.

	° ′
Mean Anomaly	243 32
Peri-neptunium	177 30
Ascending Node	175 40
Inclination	151 0
Angle of Eccentricity	6 5
Period	5^{d}·8769

If I am right in placing the lines of nodes and apsides nearly in coincidence, it will follow that, at the present date, there will be no very sensible difference between the extreme distances of the satellite eastward and westward of the primary, and this deduction appears to be borne out by a comparison of the measured distances at those points. It will also necessarily result that the satellite must pass nearer to the planet, when it is in the north-preceding quadrant, than it does in the opposite direction—a condition agreeing well with observation. At this epoch the satellite is nearest to the earth when it is to the north of its primary.

I subjoin an extract from a communication with which I was favoured by Mr. Lassell, affording strong evidence in support of the conclusions deduced above:—

"I certainly incline to the opinion that the apparent orbit of *Neptune's* satellite has diminished its conjugate axis since the earlier observations, though all but those of 1852 are made so near the greatest elongation that they could scarcely give even a rude approximation to the true form of the apparent orbit. * * I don't know whether it has occurred to you that the observations at Malta seem to indicate pretty clearly an apparent eccentricity of the orbit,—the satellite passes the planet at its nearest approach on the north-preceding side, something like a second *nearer* than at its nearest approach on the south-following side."

The semi-major axis of the satellite's orbit, as seen at the mean distance of *Neptune*, subtends an angle of 16″·98, according to a preliminary discussion of Mr. Lassell's Valetta measures, whence, with the periodic time I have given above, the mass of the planet is found to be $\frac{1}{17135}$, and the mean distance of the

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satellite from the centre of *Neptune*, 235,800 miles. I believe it will appear, from a comparison of this gentleman's measures generally with those of other observers, that they have a tendency to be in excess rather than in defect of the mean, and consequently the value of the mass, deduced from them, will possibly admit of some diminution: probably $\frac{1}{17500}$ will prove very near the truth.

December 7, 1854.

Note on the Satellites and Mass of Uranus. By J. R. Hind, Esq.

In the *Monthly Notice* of this Society for March 11th, 1853, appears an extensive set of measures of the two brighter satellites of *Uranus*, *Titania* and *Oberon*, taken by Mr. Lassell during his residence at Malta, under circumstances far superior to those which affect the accuracy of such observations in the climate of this country. I have lately worked up those measures with the view of determining the positions of the orbits of the satellites and the mass of their primary. My results are as follow:—

I. *Oberon.*

Radius of Orbit at the Mean Distance of Uranus ...... 45″·20 [or 385,000 miles]
Ascending Node ...... 165° 28′
Inclination 100 34

II. *Titania.*

Radius of Orbit at the Mean Distance of Uranus ...... 33″·88 [or 288,600 miles]
Ascending Node ...... 165° 25′
Inclination 100 34

It will be remarked that these observations give the position of the node and inclination almost precisely the same as they were found by Sir William Herschel more than half a century ago—his numbers being $☊ = 165^\circ\ 30'$, $i = 101^\circ\ 2'$.

I find from the distances of *Oberon*, mass of *Uranus* $= \frac{1}{20642}$, and from those of *Titania* $\frac{1}{20505}$, adopting Mr. Adams' periods of revolution: the mean $\frac{1}{20570}$ agrees very nearly with the value derived from the measures of Sir W. Herschel.

Mr. Lassell's observations indicate with tolerable certainty that the mass of *Neptune* is greater than that of *Uranus* in the proportion of 7 to 6.

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